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PLATE V

Albert Durrant Watson
January 8, 1859—May 3, 1926

(Courtesy of Ryerson Press)

THE JOURNAL
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OF CANADA

VOL. XX, No. 5 JUNE, 1926 Whole No. 156

ALBERT DURRANT WATSON

By C. A. CHANT

ALBERT DURRANT WATSON, the son of William Youle and Mary Ann (Aldred) Watson, was born in Dixie, a small village about fifteen miles west of Toronto, on January 8, 1859.

He received his preliminary education in Dixie and the neighbouring town of Brampton and attended the Normal School at Toronto. For a short time he taught school in Malton and Oakville and then decided to study medicine. After spending four years at the Toronto Medical School he obtained the M.D. degree from Victoria University in 1883. He then pursued his studies in Edinburgh and London and Paris, and returned with the standing of L.R.C.P.

In September 1885 Dr. Watson married Sarah G., daughter of Samuel Clare, who was writing and book-keeping master in the Model and the Normal School in Toronto, and who, it is worth remarking, with Andrew Elvins was instrumental in organizing the original Toronto Astronomical Club in 1868. Dr. Watson's first office was on Queen St., a short distance west of Bathurst St., and in 1886 he built the house at 10 Euclid Avenue where he lived until he passed away.

Dr. Watson was always interested in scientific matters and at an early date joined the Astronomical and Physical Society, which later became the Royal Astronomical Society of Canada. Just when he became a member I have not discovered, but his name is in the first printed list available, namely that for January 1893. I

also find that at the meeting of March 7 of that year it was stated that in the early morning of October 16, 1892, Dr. Watson had observed Jupiter apparently with only one satellite—two being in transit and invisible and the fourth one behind the planet.

The telescope which he used was a 3-inch refractor by Bardou which had been imported to his order by Michael, an optician on the south side of King St. near Bay. This telescope proved to be of excellent quality and was used continuously and efficiently by Dr. Watson. He seldom lost an opportunity to observe any objects or phenomena which were referred to in his reading of astronomical literature, and thus he attained a certain assurance in handling cosmic problems which is reached only through practical acquaintance with the subjects discussed.

On September 29, 1896, Dr. Watson read to the Society a paper on "The Reformation and Simplification of the Calendar", which is printed in full in the *Transactions*. He advocated the division of the year into thirteen months, each of 28 days, the days left over to have no week-day name and to be considered holidays. This proposal has been much discussed since then, its greatest advocate being Mr. M. B. Cotsworth, of Vancouver, B.C., who has prepared a statement regarding it for the League of Nations and has received letters from the leading ecclesiastical authorities expressing approval of it. Many business houses are also favourable to the proposal and I think men of science generally would be glad to see the new calendar introduced, but I fear it would come as a shock to the great mass of the people.

In 1903 on September 29, Dr. Watson read a paper on "Pleasures of the Telescope", but it was not printed.

In 1907 the publication of this JOURNAL began, and there have been few volumes in which nothing from Dr. Watson's pen has appeared. The following is a list of his contributions:

1908. "Northern Lights" (Poem).
1909. Halley's Comet and its Approaching Return.
"The Wonder Star, Mira" (Poem).
1910. Olbers: the Greatest of Amateur Astronomers.
1911. Calendars Ancient and Modern.
"Kepler" (Poem).
1913. "Copernicus," "Galileo" (Monologue Poems).
1915. Horrox.

1916. "The Bugle" (Poem).
Companions of the Sun.
1917. Astronomy in Canada (Presidential Address).
1918. Astronomy, a Cultural Avocation (Presidential Address).
"The Stars are Waiting" (Poem).
1919. "Copernicus" (Poem).
1921. "The Astronomer" (Poem).
1922. Astronomy in a Poet's Life.
1923. The Norse Discovery of America (in A.D. 1000).
"The Dawn of Night" (Poem).

Perhaps the most important of these is "Astronomy in a Poet's Life", but all are written in an excellent style and contain much interesting information.

After serving on the Council of the Society for some years Dr. Watson was elected President in 1916 and again in 1917. His presidential addresses are listed above. As a presiding officer he was always appreciative of any papers presented and full of encouragement to young persons interested in astronomy.

Dr. Watson's first book was published in 1904 and was entitled "The Sovereignty of Ideals". For a number of years he had conducted a Bible Class in the Euclid Avenue Methodist Church, which was only about one hundred yards from his house, and this volume grew out of a course of lessons on the life of Christ in his class. It was followed in 1906 by another, entitled "The Sovereignty of Character".

In 1908 his first volume of verse appeared, bearing the title "The Wing of the Wild Bird". His other volumes of poems were: "Love of the Universe" (1913), "Heart of the Hills" (1917), "The Dream of God" (1922), "Woman" (1923), and in 1924 he published his "Collected Poetical Works"—a fine volume printed by the Ryerson Press. His further prose works were: "Comrades of Jesus" (1919), "Our Canadian Literature—Representative Prose and Verse" with Lorne Pierce (1922), "Robert Norwood" (1923), "Mediums and Mystics, a study of Spiritual Laws and Psychic Forces", with Margaret Lawrence (1923). Two other works are ready for the press, "The Master Consciousness" and a lengthy poem entitled "Adrian".

A great record!

It must be remembered, also, that during the twenty years

when these were being produced, Dr. Watson was engrossed in a large medical practice. Not only was he the beloved and trusted family physician but he was also the counsellor and friend of the entire neighbourhood. When he built his house it was in an excellent residential portion of the city, but with increase of population he was at last surrounded by business houses and citizens from foreign lands. He was urged to move from this 'down-town' area to some district farther north where he would have a 'better' class of patients, and this change would certainly have been to his financial advantage. But he felt he could serve the people best where he was and there he stayed. The old civic employee who forty years ago had lighted the gas street lamps in front of Dr. Watson's office was on hand to pay his respects to him at his death.

A few years ago Dr. Watson made a serious attempt to investigate the phenomena of "spiritualism", and at the time received more public notice than he desired. I believe he was somewhat disappointed with the results he reached—or rather failed to reach. He read many papers before the Association for Psychical Research in Canada, and to the very end that which was spiritual or psychical or mystical attracted him most strongly. His views on some of these subjects are given in the work "Mediums and Mystics", in the preparation of which Miss Margaret Lawrence collaborated.

Dr. Watson's poetry is very generally of a philosophic or spiritual nature, tinged with mysticism—hard to define in scientific terms—and in many cases it has to be studied to be appreciated. But some of his descriptions are simple and impressive. I might quote his sonnet entitled "Northern Lights", which first appeared in this JOURNAL in 1908.

NORTHERN LIGHTS

Weird armies wave their scimitars of light
  And sabres glimmer in the cloudless deep
  While up the ebon battlements they sweep
With shimmering steel exultant to the fight.
They charge, contend, retreat with sudden flight,
  Then press again the battle up the steep,
  Till all the northern skies with lances leap
Around the flaming coronal of night.

But soon the legions and their splendors fade;
  Each bright battalion in the lofty arch
In midnight's scabbard sheathes his blood-hued blade;
  The ranks from zenith to horizon march
And where was camp and panoply of Mars
Is sable night pierced by the jewelled stars.

Any one who has seen a brilliant display of the aurora will agree that the above is a lively and true description of it.

For some years the present writer has been advocating the establishment of a first-class astronomical observatory in Toronto. The outline of this project, which is intended to supply the needs of the University of Toronto for teaching and for research, the Royal Astronomical Society of Canada and the citizens of Toronto and of the Province, were drawn up in Dr. Watson's office early in 1914. The Great War intervened and checked the carrying out of the scheme; but it is so desirable, and indeed so necessary, an addition to the equipment of the University and to the educational facilities of the Province, that it must be brought to a successful issue in the near future. The writer will always associate Dr. Watson's name with this great project.

Dr. Watson died suddenly in the early morning of Monday, May 3. He had conducted his Class at his home on the afternoon of the day previous, but in the evening became ill with heart trouble and in a few hours expired.

He is survived by his widow and five children: Mrs. Vernon Heakes, Camp Borden, Ont.; Mrs. Ralph Hardy, Speers, Sask.; and Clare, Harry and Dr. W. V. Watson, Toronto. The last-named is on the staff of the Faculty of Medicine, University of Toronto.

I close with the beautiful short poem contributed by Dr. Watson to this JOURNAL in 1918:

The stars are waiting till our hearts are wise;
  They glow and throb, all vibrant with the thought
That some day we, beholding with clear eyes
The deep celestial splendor of the skies,
  Shall know all beauty out of love was wrought.

SEISMOLOGY IN CANADA[1]

By Ernest A. Hodgson

(ABSTRACT)

This paper deals with the circumstances surrounding the installation of seismographs, at Toronto in 1897, at Victoria in 1898, at Ottawa in 1906, at Halifax and Saskatoon in 1915, and at Ste. Anne de la Pocatiere in 1925. These instruments and those later installed at the first three stations above mentioned together with one no longer in use at St. Boniface form the instrumental equipment available. The nature of the locations of these is dealt with and the time services described. The publications regularly issued are reported and some forthcoming reports announced. The work being undertaken in the province of Quebec is touched on. The paper concludes with a brief outline of the co-operative efforts of the seismological service of Canada in the past and declares this idea of co-operation to be the outstanding characteristic of the seismological programme now in contemplation.

THE history of Seismology in Canada dates back to the year 1897. At that time the Seismological Committee of the British Association issued a circular letter requesting the co-operation of the various governments and institutions in an attack upon the earthquake problem. The request that Milne photographic seismographs be purchased and operated in Canada was acted upon by Sir Frederick Stupart, Director of the Meteorological Service of Canada, who ordered two instruments, one for Toronto and one for Victoria, B.C. The first one, for Toronto, was received there in August 1897 and put in operation the next month. The second went into service at Victoria in October 1898. Professor Milne personally superintended the installation at Toronto while in attendance at the Toronto meeting of the British Association in 1897.

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[1]Paper presented before the First Meeting of the Eastern Section of the Seismological Society of America at Washington, May 1, 1926.

The Toronto seismograph was put in charge of Mr. J. Young, who still cares for the seismological work at that place. He is still under the same Director—Sir Frederick Stupart—but the old instrument is no longer functioning, having been replaced in May 1923 by two Milne-Shaw seismographs. Mr. Young is assisted in his work in seismology and meteorology by Mr. Carroll.

The seismograph at Victoria was, at first, in charge of Mr. Baynes Reid, Superintendent of the Meteorological Office at that place. After the death of Mr. Reid, the present Superintendent, Mr. F. Napier Denison, assumed the duties there, including the care of the seismograph. The old instrument was supplemented by a Wiechert, 80 kgm. vertical, in 1914, and in 1922 two Milne-Shaw seismographs took over the duty of recording the horizontal components of the earthquake tremors,the old Milne being given a place of honour as a demonstrating instrument for the instruction of visitors.

The first record obtained at Toronto was that of September 20, 1897. This earthquake occurred in East Borneo. From that time until the present the records from Toronto have been practically complete, possibly the longest series of its kind on this continent. At the British Association Meeting in Toronto, in August 1924, the first Toronto seismogram was exhibited by Mr. Young the investigator who had obtained it. Up to January 1923, and since January 1899 this Milne seismograph recorded 2,384 earthquakes.

The seismographs at Ottawa are of later date. In 1905 the late Dr. Otto Klotz was placed in charge of Seismology, Terrestrial Magnetism and Gravity at the Dominion Observatory, Ottawa. In the same year an order was placed for two components of Bosch photographic seismographs. These were received and installed in January 1906. One of the first large records obtained was that of the San Francisco earthquake of April 18, 1906. This and subsequent records up to April 1, 1908, were not reported and, with the exception of a half dozen large ones, none preserved. Beginning April 1, 1908, the earthquakes were given serial numbers, a series which has continued to the present, the last record at the time of writing being No. 2421. All these records are preserved, filed and indexed.

In March, 1912, a Wiechert 80 kgm. vertical was installed at Ottawa. This has continued to operate ever since. The accidental re-discovery by the writer of the effect on writing friction of a rapid jarring of the stylus (first noted and reported by Marvin) was followed by the installation of a buzzer device which keeps the writing point in a continuous slight tremor, on and off the paper. The instrument has since then recorded quite as well as the Bosch, even small microseisms being well shown. A thermostatic control was provided in 1921 which has materially lessened the trouble caused by fluctuations in room temperatures.

In July, 1915, a tilt recording seismograph, which is referred to always as the "Deformation Instrument" was obtained from the International Seismological Association. This is one of four which were to be placed respectively in Canada, France, Siberia and South Africa to measure the deformation of the earth by the moon. The work of Michelson on this subject was done with instruments so much more accurate and sensitive than the pendulum apparatus supplied, and the difficulties of maintaining satisfactory working conditions for the instrument were so great that it has been set at a free pendulum period of 30 seconds and maintained at a low paper speed of about 15 mm. an hour as a check on the seismographs. A very interesting phenomenon of cooling has been discovered through this instrument, so sensitive to tilt and so carefully housed in an underground vault. This was described in a lecture delivered yesterday before the Section of Seismology of the Geophysical Union.

In 1915 arrangements were made by the Dominion Observatory with Dalhousie University at Halifax and with the University of Saskatchewan, Saskatoon, whereby the Observatory agreed to furnish and install at each university a Mainka bifilar horizontal seismograph of two components and the necessary paper supplies if the authorities of the university in each case would undertake the work of looking after the instrument. These seismographs have been in operation ever since although each has been once moved and reset, the one at Halifax to secure better thermal conditions and the one at Saskatoon to secure more suitable quarters in the new physics building. At Halifax, Professor Bronson is in charge of the Physics Department and Dr. J. H. C.

Johnstone has the immediate care of the seismograph. He gives much of his time from the busy life of an academic position to maintaining the seismograph in working condition and in forwarding the records. The head of the Physics Department at Saskatoon at the time the instrument was installed was Dr. A. G. McGougan. Since his death the head of the department has been Dr. E. L. Harrington. Mr. Grant has, from the first, been in immediate charge of the seismograph. His care to keep it in order and his, almost meticulous, neatness in the matter of indexing and filing the records for forwarding are worthy of special mention in this paper.

In May, 1922, one component (No. 17) Milne-Shaw seismograph was put in operation at Ottawa, and in December of the same year another (No. 23) was added. These have been in operation ever since although No. 23 has been used as an experimental seismograph, having been set up at two different stations near Ottawa for the purpose of securing records to compare with the ones at the home station.

In April, 1925, a Milne-Shaw which had been obtained several years ago by McGill University for investigating the effects of the passsage of trains in an underground tunnel through the mountain in Montreal, near the University, and which had not been in use as an earthquake recorder for some time, was purchased by the Dominion Observatory and installed at Ste. Anne de la Pocatiere in the basement of the Pathological Laboratory of the Ste. Anne Station of the experimental farms of the Department of Agriculture. The arrangement for co-operation between the two departments of the government has been kindly brought about, at the request of the Observatory, through the efforts of Mr. Güssow, Chief of the Division of Botany. The laboratory is directly in charge of Mr. H. N. Racicot who, with the assistance of a stenographer, Miss Treshy, undertakes the work of attending the seismograph and forwarding the developed records to Ottawa. This work, taken on in addition to his activities as Plant Pathologist in charge of the laboratory, is a marked contribution to the work of seismology in Canada. A very fine record of the New Hebrides earthquake of April 12, 1926, has just been received from this seismograph.

The records from the seismological stations of the meteorological service at Toronto and Victoria are evaluated by Mr. Young and by Mr. Denison respectively. The stations at Ottawa, Halifax, Saskatoon and Ste. Anne are managed by the Dominion Observatory, Department of the Interior, Ottawa, of which Mr. R. Meldrum Stewart is the Director since the death of Dr. Klotz in December 1923. The records from the outside stations of this group are forwarded to Ottawa for reading by the staff here. Ernest A. Hodgson, the seismologist, is assisted by Mr. W. W. Doxsee, the assistant seismologist and Miss Helen Gormley. Since the first of September 1925 Mr. Doxsee has been given charge of the work of reading the records and preparing the monthly bulletins.

No outline is given in this paper of the seismological work of the Jesuit Station at St. Boniface in Winnipeg. This station has been inoperative for some years. It will probably be discussed in the paper by Dr. Macelwane, in the province of which it more properly falls.

The instruments at Toronto are in a basement room of one of the University of Toronto residences. The pier and its conveniences of switches and lamps, etc., is a model of neatness and efficiency. The sub-soil is sandy. Those at Victoria are installed in a basement room of the new and beautifully designed meteorological observatory on Gonzales Heights. All rest on one massive concrete pier which is built directly upon the igneous rock below the observatory. The surrounding floors are of wood. Visitors may walk about the pier without disturbing the Milne-Shaw records although the sensitivity is very great, the 12 second period and 250 fold magnification being maintained.

The Milne-Shaw seismographs at Ottawa are mounted on a single massive pier resting on glacial clay in a vault room whose floor is fifteen feet below ground. No buildings are over this vault. No diurnal tilt affects them at the 12 second period and 250 fold magnification. It is a most satisfactory seismograph room. The other instruments at Ottawa are at the basement floor level except for the deformation instrument which is in a special vault whose floor is twenty feet below ground level and above which no building is placed. The subsoil in each case is glacial clay.

At Saskatoon a very neat arrangement of the Mainka installation is placed in a special basement room of the new Physics Building of the University. The subsoil is clay and sand to a considerable depth.

Dalhousie University has made a special effort to provide a satisfactory location for the seismograph. Temperature changes due to the proximity of the boiler room gave much trouble at first. Finally, about two years after the instrument was installed in 1915, Dr. Bronson had an insulating room built about the seismograph after placing it on a newly constructed and properly oriented pier at the level of the basement floor. It now operates quite satisfactorily. A valuable record of the Halifax explosion was obtained from this seismograph.

At Ste. Anne de la Pocatiere a room was set apart in the basement of the laboratory. The electrical connections were provided for by conduits built into the pier designed for the purpose. The installation is a model one except for the unavoidable condition that a laboratory and dwelling lie above it and that stable conditions for recording are obtained only at night.

The time services controlling the records at the various stations vary. The Toronto and Victoria seismographs have signals from the regular time clocks of the respective observatories, regular transit observations being used to check the service. Time is correctly marked on the record to within a second.

Those at Ottawa are provided with accurate signals by the time service of the Dominion Observatory at which regular meridian circle observations are carried on and daily corrections applied to the mean time clocks after chronograph comparisons with the Riefler. Time signals as marked on the record are maintained correct to within a fifth of a second.

The time at Saskatoon is marked by a pendulum clock provided with contacts as supplied with the seismograph. It is not a good system. Time cannot be certainly known to within perhaps several seconds. An arrangement is being made to have checking eclipses put on the records by an observer listening in to radio time signals. It is hoped that this will enable the rate of the recording clock to be determined and time at any given point computed as required to within a second.

The time at Halifax is also marked by the pendulum clock supplied with the seismograph. It is checked each hour, however, by a signal sent in over a Western Union Telegraph line. It is doubtful whether this signal can be depended on to a second or even several seconds. If it were to be depended upon the system would be quite satisfactory in practice, the hour signal giving a check on the clock which would enable time to be determined quite readily to within a second at any point on the record.

At Ste. Anne de la Pocatiere the time is marked on the record by a Dent box chronometer with a uniform rate of somewhat less than a second a day. This chronograph is checked at least once and sometimes twice a day by radio signals, which Mr. Racicot or Miss Treshy record on the seismograms by means of a key near the radio receiving set installed for this work. Time can be determined with ease and precision to within a second.

With regard to publications it may be said that Toronto and Victoria regularly issue mimeographed monthly bulletins to the various seismograph stations of the world, giving their readings of the seismograms obtained. These are also printed in the regular issues of the Monthly Record of Meteorological Observations of the Meteorological Service of Canada as they appear. A yearly summary is also published. The work done at Victoria by Mr. Denison on the tilting caused by the tides has been a valuable contribution to seismology. A report is given in the September issue of the Bulletin of the Seismological Society of America for 1913. The subject has been dealt with also by him in papers given at the British Association meetings of 1901, 1908 and 1911 as well as elsewhere. Mr. Denison has obtained some interesting records from the tide guage records at Victoria which show the velocity of tidal waves caused by an earthquake in Chile to be of the order of 400 miles an hour. The location of the Victoria station on the Pacific Coast where a complete record of tremors is important make the records of added interest.

The mimeographed bulletin froms the Dominion Observatory give the readings of all the seismograms recorded at Ottawa as well as the readings of those obtained at Saskatoon, Halifax and and Ste. Anne de la Pocatiere which are sufficiently well marked to yield a value for distance. A yearly publication of these data

is also issued in printed form as one of the series of Publications of the Dominion Observatory.

Since March 1925, the work of Mr. G. M. Massey of the city of Quebec has enabled the Observatory to include in the monthly bulletins a report of those tremors locally observed in the lower St. Lawrence region. This service is a valued one and permits a more complete record to be kept of local disturbances in that seismic area.

A complete series of locations of epicentres has been prepared year by year covering the records since 1911. The issue for 1922 is ready for the press now and that for 1923 is being rapidly completed. All earthquakes of which a trace is found at Ottawa are included in a scheme of correlation of data from all reporting seismological stations. The locations are only approximate—no account is taken of depth of focus—but the work has been throughout on the same basis and forms a continuous series of analyses of the records of well-marked earthquakes.

Publications dealing with the results of seismological research and papers on the progress of the work are published from time to time. A lengthy report on the St. Lawrence earthquake of February 28, 1925, is now being made ready for publication. It embodies the results of instrumental records, questionnaires and personal investigations. It is being augmented by similar material obtained by the U.S. Coast and Geodetic Survey and supplied by them, dealing with reports and records in the United States and also by the seismographic records of many stations, notably Georgetown University, which was geographically well situated for that earthquake and was, fortunately, in possession of a Galitzin vertical seismograph.

Believing that no observations, however accurate, are worth making unless the circumstances under which they are taken is being carefully recorded and made readily available for comparison, an earnest attempt has been made to systematize the seismological work of the Observatory, to outline its history in detail, to provide automatic correlations of similar data as observed, to record completely the circumstances under which the records were obtained and to insure a continuity of programme and routine.

A publication dealing with this part of the work is now ready for the press.

Following the St. Lawrence earthquake an effort was made to bring to the attention of the commercial interests (financial, engineering, etc.) of Quebec the need of including the earthquake factor in their analyses of building problems in that province. As a result of this, one of the large electrical development companies has asked for the co-operation of the Dominion Observatory in their installation of Wood-Anderson seismographs near two of the power sites. The order for these instruments has already been placed. The need of accurate geodetic surveys is being met by the Geodetic Survey of Canada who are placing a net of precise triangulation over each area. Precise levels will also be carried there and an effort will be made to have bench marks placed in strategic positions at each place. The assistance of the Geological Survey is being sought to enable the placing of the triangulation points and the seismological laboratories to be done to the best advantage. It is hoped that these installations will indicate something of the seismic activity of the Quebec area and initiate a comprehensive investigation of earthquake conditions in a province in which such extensive water power developments are being undertaken.

Canada has for many years taken part in international organizations in seismology. Through the efforts of Dr. Klotz she took active part in the International Seismological Association. He was the delegate from Canada at the second conference of the International Seismological Association at the Hague in 1907; the third conference at Zermatt in 1909; the fourth at Manchester in 1911 and was on his way to St. Petersburg for the fifth in 1914 when war broke out and the meeting was abandoned. Dr. Klotz was present at the meeting in 1922 in Strasbourg at which the old International Seismological Association was disbanded. He proceeded directly from that meeting to the First General Assembly of the International Union of Geodesy and Geophysics held in Rome the same year. His many scientific friendships in Europe, in Asia, and on this continent resulted in the work in Canada being kept in touch with that of the rest of the world. Mention must be made of the friendship and co-operative efforts in the

first stages of seismology in eastern North America of Woodworth of Harvard, Tondorf of Georgetown and Klotz of Ottawa, who compared notes, exchanged seismograms, and vied with each other in improved and promptly issued bulletins. Happily, Father Tondorf continues that work in Georgetown to-day, co-operating still with the observatory at Ottawa.

This idea of co-operation, domestic, international, and world-wide, co-operation between the individual members of the staff at the Dominion Observatory, between that organization and the Meteorological Service, the Geodetic Survey, the Geological Survey, and private commercial interests and individuals in Canada, between the workers in Canada and those in the United States, by means of this newly-formed Eastern Section, between the organizations of this continent and those of the rest of the world in the International Union of Geodesy and Geophysics—this idea of united effort has been reserved as a fitting one to form the conclusion of this paper on Seismology in Canada, expressing as it does, the motif of the seismological programme now in contemplation.

Dominion Observatory,
Ottawa, Canada,
April 26, 1926.

THE THEORY OF ETERNAL RETURN AND ASTRONOMY*

By Pierre Salet

IT was in 1871 that the celebrated revolutionary Blanqui[1] composed the curious pamphlet entitled *Eternity by the Stars*,[2] while he was expiating one of his numerous political sentences in a dungeon at Fort Taureau. In this work Blanqui deduces with mathematical accuracy his ultimate conclusion from the following axiom, which he admits without discussion: Space and Time have no limits, and everywhere and always are occupied by stars (celestial bodies) analogous to those which surround us (now).

This idea, which seems so natural to astronomers, is doubtless only a hypothesis, and Blanqui as a sub-title termed his book "An Astronomical Hypothesis." But this hypothesis has at least the advantage that after that fashion we can best conceive the Universe: We cannot as a matter of fact conceive of limits to either time or space, and we are also incapable of imagining regions of space where the laws which govern matter about us, and which have given birth to our Stellar Universe, would cease to apply. In fact it is in this way that *savans* (in all lands) explain the origin of star-systems in the celebrated theory of *Island Universes*. Each one of the minute spiral nebulae which is perceived in the profound depths of the Heavens must be in reality an immense mass of stars,

*Translated from *L'Astronomie*.

[1](Louis Auguste Blanqui, noted atheist and anarchist, gave the Government much trouble toward the end of the Second Empire and at the beginning of the Third Republic. His motto was: "Neither God nor Master.") Trans.

[2]This little book has become very scarce; it contains a part purely astronomical against the theory of Laplace, which is of no value, as the author was incompetent to treat that subject. But the philosophical ideas of Blanqui deserve to be recalled.

a *Milky way* like our own, and containing as does that, billions of suns. And the stars which compose those masses are formed and dissipated without beginning or end.

Whatever be the value of this conception, Blanqui admits that space and time are (alike) without limits and contain an infinite number of stars analogous to those known to us. But he remarks that, on the contrary, the number of chemical combinations, and of the forms which living beings may assume, while certainly very numerous, is, as certainly, limited.

The number of simple bodies (chemical elements) is limited, and consequently also, that of their combinations. Spectrum analysis also tells us that the heavenly bodies are composed of these same elements. On the other part the dimensions of living beings evidently cannot surpass certain limits; the number of molecules of which they are composed is also, then, limited as well as the number of arrangements of these molecules and the number of forms which result. It seems then, indiscutable that in the infinity of space and time there must infallibly be produced repetitions more or less exact and even *sosies* (duplicates) identical with our own bodies. We are confronted with infinity in Time and in Space, while Nature can only furnish for each new being a number, very great indeed, but limited, of types. In searching, then, among the innumerable stars of all the star groups which people infinite space and which succeed each other indefinitely in time, one must therefore meet with planets similar to our own and peopled with identical (living) beings. That which we are to-day we have been formerly, and will be again an indefinite number of times.

"That which I am writing to-day, at this moment in a dungeon," said Blanqui, "I have written, and I will write during eternity, on a table, with a pen, under conditions entirely similar. The entire life of our planet from beginning to end is reacted day by day, upon myriads of other brother-worlds. The Universe repeats itself without end, as on a parade ground. Eternity plays imperturbably in its infinity the same dramas."

We have already remarked that if we consider alone the repetitions which must be reproduced during (periods of) time, this theory is identical with the *Eternal Return*, to which ten years

later, Nietzsche was to give celebrity, thanks to the prestige of his brilliant style. Nietzsche also sought to establish this theory on scientific foundations, and it is said that with that view he had dreamed of devoting ten years of his life to the study of physics and natural history. But he quickly renounced that idea; and otherwise the nature of his genius could not be conformed to an attempt to *prove* the new ideas of which he believed himself the prophet (apostle) and "which were to throw the world into convulsions." It was then solely upon the value of his own intuition that Nietzsche has based his idea of Eternal Return, that bewildering idea which traversed his mind like a lightning-flash, the announcement of an incomparable thing, "when he found himself upon a mountain 6000 feet above sea level, and very much higher above all human things."

Nevertheless, that idea was not absolutely new, and traces of it are found in certain ancient philosophers. We know that formerly there was what was called "*The Platonic Year*," a long period of time at the end of which everything must become the same as it had been primitively. But in spite of the name, "The Platonic Year" was not announced by Plato, we believe, but is found in one of the commentaries on that philosopher's (works) due to Olympiodorus. There our theory is established upon an astronomical basis.

In the system of Ptolemy, we know that each star was carried and moved by a different sphere. "There are seven spheres," said Olympiodorus, "and as well that of the fixed stars. The sphere of the moon is found in its primitive position at the end of 30 days. The revolution of the sun is slower, being made in a year. Jupiter returns to his point of departure in 12 years. Saturn in 30 years. Any two of the stars (planets) are not found to arrive simultaneously at their point of departure, but at the end of a very long period of time. Jupiter and Saturn every 60 years, etc. However, the seven spheres finish by returning all at a (certain) time to the same situation relative to the heaven (of fixed stars) but after many millions of years.[3]

[3]At present with the number of minor planets and the precision of the measures of the times of revolution, the Platonic Year would have a duration so immense as to be quite beyond conception.

During the middle ages certain philosophers believed that at the end of the Platonic Year souls and bodies must reunite, to commence a new life similar to that which had preceded; others were of opinion that only the celestial bodies would be found at the end of that time in their identical (original) positions.

In the Orient the idea of the Eternal Return has remained to our day under the familiar belief in successive re-births (transmigrations). We might also connect with the same idea the doctrine of the Kâlpas, those immense periods of activity and repose, during which the Universe alternatively sleeps and develops by turns. Modern science and the ancient philosophy of India arrive at the same conclusion: Matter is eternal, but it unceasingly creates new worlds. Following the ancient comparison, these destructions and re-births are like a great wheel which rotates unceasingly, or like a circle which has neither beginning nor end.

"Just as the birds at the close of the day all fly back to the family tree, so, at the end of each day of Brahma, all the Universe re-enters the bosom of the Supreme Soul "(Being).

Without doubt it was from the philosophy of India that Dr. Gustave Le Bon has drawn the ideas which he published at the same epoch as (did) Nietzsche.[4] But while in the Hindoo philosophy the idea of the perpetual renewal of the world was purely mythical, Gustave Le Bon founds this theory on the basis of Cosmogony. He accepts the view, familiar now to astronomers, following which stars are born, pass through evolutionary stages and finish by dying (only) to be reborn anew.

"This globe, silent and dead, will not forever roll through space a cold inert mass. It is destined, doubtless, to form a new nebula, from which will come out by a series of analogous evolutions, another world also destined to be inhabited one day, only again to perish in its turn, without our being able to foresee a limit to this eternal series of births and destructions.[5]

"But if they are the same elements of each world which served after its destruction to reconstitute others, it is easy to comprehend that the same combinations, that is, the same worlds, inhabited by the same beings, must be repeated many, many times.

[4] *Man and Society.* 1881.
[5] Ibid.

"The possible combinations which a given number of atoms can form being limited, while time is unlimited, all the possible forms of development have necessarily been realized since long ago, and only combinations already attained can be anew repeated. Like Sisyphus forever rolling the same rock we repeat unceasingly the same task, while nothing can set a limit to this fatal *forever*. What unknown regions of the skies may shelter the supreme *Nirvana*, that final repose of which the ancient religious of India dreamed? Shadows of times past which seem to vanish forever in the mist of the Ages, and which the magic wand of Science evokes at its will, hope not for repose, you are immortals."

Among the writers nearer to our own time one might doubtless find other indications of the theory of The Eternal Return; but in Europe at the epoch of Blanqui, it was truly an unknown idea which the author of *Eternity by the Stars*, shut up in a dungeon, alone and without books of any sort, had the power to re-discover, and which he endeavoured for the first time to support by the data of modern science. The name of Blanqui deserves, then, to be attached to this theory, and to be remembered whenever it is recalled. This kind of scientific renown in no respect is changed by the opinion which anyone may hold as to the socialistic ideas or the political actions of the celebrated popular agitator.

As for Nietzsche, his doctrine of the Eternal Return is not founded on an astronomical or cosmogonic idea, but more or less on an intuition of physical laws. What properly belongs to him are the philosophical conclusions which he drew from these.

Blanqui had remarked the desolating consequences of this perpetual recommencement, the negation of all human progress which is chained to every world, and vanishes with it. But Nietzsche who, unfortunately for himself, philosophized with all the passionate ardour of his soul, must have felt with extraordinary acuteness the nightmare of this eternal return of all our miseries physical and moral. He never believed, as did Buddha of old, or as his own master, Schopenhauer, that man could escape "from the rock-walls of his birth, from suffering and from death" by an act of his (own) spirit, annihilation of all desire, or negation of the will to live. But he thought that since man is condemned to re-live indefinitely the same life, he ought himself create the value of this

life, by giving to himself a new sense, wishing (it) to be more enthusiastic, more beautiful, "more tropical." "We ought to accept this life quite joyfully and desire to live an infinite number of times that we may surmount the disgust and the fear which assail us on thinking that 'the small man' and the unhappy will come again in the future indefinitely. We must reach the comprehension that meanness and misery are indispensable as reasons for the coming of the *Superman*, and that suffering is legitimate as the price to be paid for all the joys to come."

If we admit that space is Euclidian, as Blanqui premises, that is to say, the illimitable character of space and time, it serves naturally to impose on our minds as perfectly admissible that the series of stars which exist in space, or which shall succeed these in time (to come), is not limited.

However, this question belongs (properly) to the domain of metaphysics, and Newton has reminded *savans* that they ought not to venture on that dangerous ground. In fact it is prudent in these scientific jousts "to keep out of the mêlé." The Abbe Moigno, who maintained that the world could neither be infinite nor eternal has he not written that as regards this question? "Unbelief is not in the mind, but in the will or the heart; consequently it is inexcusable; and is a crime rather than a misfortune." Mr. Fred. Campbell has qualified as "contrary to sound reason" the idea that the Universe could be infinite. We do not admit (however) the applicability of these reproaches in touching on a metaphysical subject very well known, since it is the first of the famous antinomies (contradictory laws) of Kant.

We know that, according to Kant, the application of pure reason to these transcendental questions, and, without any false reasoning, ends in one or the other of two contradictory results: The world is infinite or the world is not infinite in space and time. It is then imprudent to dogmatize in such a matter, for that would be to impose our personal opinions under the guise of logical concepts. We can but simply say that the world *may be* infinite. But we must note, however, that M. Couturat, contrary to the school of neo-critics, reaches the conclusion that the hypothesis of a Universe infinite in space and time is not only *possible* but more *probable* than the inverse hypothesis, and this point of view will

doubtless be more pleasing to astronomers than the idea of a Universe forcibly limited in space and time.

But scientific research requires postulates, just as the moral (philosophy) requires a base, though the need of it may not be demonstrable. If from the metaphysical point of view the savan may suspend his judgment on the question of knowing whether, or no, the Universe is infinite, from the viewpoint of practical reason, so to speak, he must be cautious in his choice.

If infinite space is peopled everywhere with stars similar to those which surround us, distributed everywhere with analogous density, the astronomer must explain why the Heavens have not everywhere the same brightness as the disc of the sun. He must also resolve the well-known contradiction arising from Newton's law of attraction. If, on the contrary, the number of the stars is limited, matter would form a sort of island in the midst of infinite space; he must then explain why the energy which is lost constantly in empty space, and matter itself, are not exhausted. All the cosmogonic questions which bring in the degradation of energy, "calorific death," etc., assume one of the two antinomic affirmations of Kant. I indicated in a former article why, in my judgment, the postulate of an unlimited Universe seems to impose (itself) in astronomical researches. In fact, Arrhenius, for instance, admits this postulate *a priori*, and seeks by his theories to explain the consequences.

The question of the limitation of the number of forms which beings might take is also controversable, but may be brought back upon more solid ground of science. That the number of forms is limited, it is not sufficient, as Blanqui seems to believe, that the dimensions of beings are limited, as well as the nature of the molecules from which they are formed; (and) again, it is necessary that the notion of continuity be excluded from all the peculiar characteristics of these beings.

True, (modern) physics seems to incline in that direction. Atoms have been formed of identical electrons which must be found at given distances from the centre (proton) of the atom. The emission of energy is made discontinuously by *quanta*. But there remain many domains which retain the notion of continuity. It seems clear that the position of two bodies with respect to one

another might vary continually, and consequently give rise to an unlimited number of different combinations. We see no reason why space itself should resemble a checkerboard, on which the pieces, representing bodies, would only have the right to occupy certain (given) positions of limited space, and be obliged to jump in a discontinuous fashion from one square to another. The number of relative positions of a limited total of bodies may, then, be unlimited. So long as it has not been proven that continuity must be completely banished from physics, we may always think that the action of physical forces must produce, in the Universe, not as assume Blanqui or Nietzsche, a repetition of beings always identical, but rather an indefinite sequence of forms always new.

To-day a more serious objection might be raised against the idea of Eternal Return. The theory of Einstein leads, as is well known, to the conclusion that space, although unlimited, must be finite, and that the sum total of matter in the universe must be limited. Under these conditions there would no longer exist in space an unlimited succession of stars where could be found the *sosies* (duplicates exactly alike) of which Blanqui speaks. All the living beings of the world must be different in some respect, as the leaves of a tree, (while) limited in number, need never be absolutely identical.

This is, in effect, what must occur in space at a given moment; but the theory of Blanqui assumes two infinites, Space and Time. If the theory of Einstein deprives us of the former the second remains always. The Universe is renewed indefinitely, and if, as Blanqui supposes, the number of possible forms for beings is limited, there must of necessity be a recurrence of the same forms at the end of a certain (period of) time. The Universe is, forever, only a repetition of identical phenomena.

Thus, we may believe, Nietzsche comprehends the idea of Eternal Return. According to him the forces developed in the Universe are a constant quantity (principle of the conservation of energy), and therefore the sum is limited. The physical forces can never attain a position of equilibrium, for if so, they would have done it long ago; everything would have been plunged in repose, from which it could never emerge. There must, then, exist

a great movement of flux and reflux which infallibly brings back, after the lapse of a certain time, a state of the Universe identical with that which existed at a given time (previously). "All things return eternally, and we ourselves return with them; we have already been here an infinite number of times and all things have been (along) with us. There is a great year of the future, an enormously great year. It must be like a sand-glass unceasingly turned, flowing, emptying, beginning again anew. So one day will return the network of causes with which I am bound up; (and) it will recreate me, for I myself make part of the causes of the eternal return of everything. And I will come back with this (same) sun and this earth, not for a new life, or a better, or a life resembling this; I will come back eternally for this same life, identically similar."

But we might go further, and the theory of Einstein opens a door in this domain to all the fantasies of the imagination. If this theory seems to do away with infinity in the number of the stars, we can still find this infinity under another form.

When we think of a Euclidian space and an absolute time, it would seem difficult to admit the existence *elsewhere* of another space and another time which could contain *other* stars beside the infinite assemblage from which we derive our time and our space. But the space-time of Einstein has no reason to be (regarded) as unique. Since this space-time is a section of a hyperspace, as a spherical surface is a section made in a space of three dimensions, why could there not be other sections of this hyperspace, or of another? (and) since the theory of Einstein leads to the consideration of space with more than three dimensions, there is no reason to stop there. We can suppose that outside of our space-time might be found others, an infinity of others if you will, which are only positions in other points of a space having a much greater number of dimensions; similarly there might exist an infinity of plane-Universes which would be only sections of a space of three dimensions.

Similarly one might (continue to) make suppositions even more eccentric; and Blanqui, if he were living to-day, would have no trouble to conceive, with the new theories of space, an unlimited

series of stars to be populated according to his dreams and his hopes of renaissance.

It seems that the idea of Eternal Return could always be reconciled with the theories of physics, but rightly comprehended this idea must rest (belong) always to the domain of metaphysics and can never be considered as a consequence of the (former) theories. All the same the ideas of Blanqui and Nietzsche deserve to be recalled, for their boldness must always be pleasing to all investigators.

"I address myself to you, adventurous spirits," said Zarathoustra, "who have embarked, with sails filled with cunning (daring courage) upon the sea of terror, you who find intoxication in enigmas, who are most happy in semi-obscurity, who let your minds be attracted as by the music of flutes toward most dangerous gulfs."

It is to such intrepid navigators (in the realm) of thought that the reveries and the astronomical hypotheses are dedicated which I have wished to draw from oblivion.

In such matters one is but too often tempted to think himself a new Cortez about to discover and appropriate a fabulous Eldorado of (previously) unknown cosmogonic theories. Thus it is well sometimes to recall the names and the labours of the pioneers for whom such (lines of) thought were truly unexplored (ground), and whose minds have been strong enough to build up, on these new data, not indeed really solid physical hypotheses, but philosophical theories, of which the style and the grandeur must always command our admiration.

A REVISED ORBIT OF BOSS 1275

By W. E. Harper

An orbit of this double-lined spectroscopic binary was published in 1918 by Mr. J. B. Cannon in the *Dominion Observatory Publications*, Volume IV, page 185. The period then determined, 27.43 days, seemed to be the correct one, even though some of the observations gave rather ragged agreement with the curve.

A couple of years later the present writer noted that a short period seemed to satisfy most of the observations but his communication to Mr. Cannon apparently went astray in the mails and nothing was done about it. Recently at Victoria in obtaining spectra of A-type stars for absolute magnitude work the rapid shift of the spectrum lines again emphasized the apparently short period character of this binary, and it was felt advisable to secure the correct period and other orbital elements.

As Mr. Cannon has been out of spectroscopic work for some time he asked the writer to undertake the necessary revision. The period suggested by the Victoria plates alone is 2.15 days, which period also satisfies the Ottawa observations much better than the longer one originally determined. Connecting up the two series of observations it was found that either of two periods was possible, namely 2.15165 or 2.15236 days. The former value was preferred as only ten of the Ottawa observations fell on the wrong branch of the curve, whereas with the latter value there were thirteen or fourteen.

It was here realized that a re-examination of the Ottawa plates was desirable and through the kindness of the Director, Mr. R. M. Stewart, they were forwarded to Victoria. While the component spectra are much alike, yet one is somewhat stronger than the other and on well exposed plates the two spectra are readily distinguishable. The Ottawa plates are weak in the violet and

are sometimes not of the best definition so that if one took an average of all the component lines there would be a likelihood that the components would be assigned as in the previous publication. By paying attention, however, solely to the 4481 line of magnesium,—a proceeding warranted by the uniformity of exposure in that region—the writer found that with the period 2.15165 days the component velocities in every case fell on the proper branch of the curve.

With this period the Mount Wilson observations are in accord. A circular orbit with semi-amplitudes of 113 and 130 kms. per sec. is obtained. Moreover the values of $m_1 \sin^3 i$ and $m_2 \sin^3 i$ are respectively 1.7 and 1.5 instead of each being 18.0 times the sun as formerly. A more detailed article will appear as a Publication of the Dominion Astrophysical Observatory.

TWO SPECTROSCOPIC BINARIES, H.R. 2962 AND H.R. 5472

By W. E. Harper

I. *The Orbits of the Spectroscopic Components of H.R.* 2962

The binary character of this star has not hitherto been announced. It was discovered early in 1924 by the writer and 28 plates secured since then are used to determine the period and other elements of its orbit. The spectra of both components have been measured and are of type F3 or thereabouts, with one considerably stronger than the other.

The variation in velocity is small, the semi-amplitudes being 45 and 52 kms. only. Thus the component lines at their maximum separation are not greatly in excess of the limit of resolution of the one-prism instrument and it is considered quite satisfactory to have obtained the orbit when for fully 75 per cent. of the period the lines would, under normal conditions of observing, be partially or completely superposed. By narrowing the slit it was possible to get the lines resolved where the separation was not over 80 km. and thus the velocity curves are fairly satisfactorily determined.

The orbital elements are as follow:

$P = 31.50$ days
$e = 0.208 \pm .045$
$\omega_1 = 44°.0 \pm 4°.0$
$\omega_2 = 224°.0 \pm 4°.0$
$K_1 = 45.18$ km. ± 1.94
$K_2 = 52.43$ km. ± 2.49
$\gamma = -12.11$ km. ± 0.42
$T =$ J.D. $2{,}423{,}884.45 \pm 0.33$ days
$a_1 \sin i = 19{,}142{,}000$ km.
$a_2 \sin i = 22{,}214{,}000$ km.
$m_1 \sin^3 i = 1.53 \odot$
$m_2 \sin^3 i = 1.32 \odot$

The probable error of a plate is for component I ± 3.4 and for component II ± 2.6 km. per sec.

A parallax of 0″.02 is deduced by the spectroscopic method from six pairs of lines.

II. *The Spectroscopic Orbit of H.R.* 5472

This spectroscopic binary was discovered at Victoria in June 1923. Four plates of that year, four of the following year and twenty-one of 1925 were deemed sufficient to determine the orbit as the numerous lines of its F5 spectrum permit fairly accurate determinations of its radial velocity to be made.

It was found necessary to confine attention solely to the 1925 series of 21 plates which were fairly well distributed over one cycle with a period of 101 days. The four observations of 1924 fell below the curve whilst those of 1923 were slightly more below, suggesting a change in the velocity of the system.

A change of 1 km. every 85 days would cause these observations to fall on the curve but it was felt best to use the 1925 series alone from which the following elements resulted:

$P = 101$ days
$e = 0.101 \pm .019$
$\omega = 134°.12 \pm 9°.39$
$K\ (1925) = -4.44 \pm 0.24$ km.
$\gamma = 18.88$ km. ± 0.36 km.
$T =$ J.D. $2{,}423{,}581.68 \pm 2.60$
$a \sin i = 26{,}086{,}000$ km.

Indicative of the orbit being fairly well determined it may be stated that the probable error of an observation is less than 1.5 km. per sec., a value considered quite satisfactory for single-prism dispersion.

Observations from time to time will be made and their residuals from the 1925 curve used to determine the period and amplitude of variation of the velocity of the system. At present the results are: 1923, −7.6; 1924, −6.9; 1925, ±0.0; 1926, +3.6.

The period of the spectroscopic pair about the third body may be as much as five or six years judging by these limited results.

Dominion Astrophysical Observatory,
Victoria, B.C.

NOTE ON MR. CROMBIE'S ARTICLE "WHEN VENUS IS BRIGHTEST"

By Bernard H. Dawson

IN the March number of the Journal of the R.A.S. Can., just to hand, I read with interest the article "When Venus is Brightest", in which Mr. Crombie deduces, with certain simplifying assumptions and by geometrical considerations, the condition for greatest brilliancy of Venus. His assumptions of circular and coplanar orbits differ but little from the true circumstances, and in the case of Venus the further assumption, that the brightness varies as the apparent area of the illuminated portion of the disc, is also luckily not far from the truth. Consequently the results obtained do not differ seriously from those of rigorous computation. Yet it occurs to me that the exact determination on the basis of authoritative values is not excessively complicated.

Volume 8, Part 4, of the "Publikationen des Astrophysikalischen Observatoriums zu Potsdam" consists of a discussion by G. Müller of his photometric observations of planetary brightness. The general results for Venus are treated on pages 313-324, and the last three pages of this discussion are devoted to the question of greatest brilliancy. He first gives a summary of those previous investigations which were based on the same simple assumptions made by Mr. Crombie, expressing the result in two simple trigonometrical equations whose numerical solution differs by a minute of arc from that found by Mr. Crombie; then he mentions the results obtained successively by Lambert, by Bremiker and by Kies from other hypotheses, and finally he discusses the problem from the point of view of the *observed* variation of brightness with phase, computing values for each of the nine cases resulting from the successive combination of the least, mean and greatest distances of Venus from the sun with the least, mean and greatest distances

of the earth. The extreme results are 117° 4′ and 120° 8′ for the angle SVE; 38° 59′ and 39° 50′ for the angle SEV, and 38.8 days and 32.5 days for the time from inferior conjunction. He then closes his discussion with the remarks:

"By means of these values one can determine beforehand with sufficient accuracy, the time of greatest brilliancy. But in practice it will perhaps be somewhat easier and surer to find first a roughly approximate value for the epoch sought and then to compute the stellar magnitude of Venus for several days before and after this epoch by means of the formula:
$h = -4.707 + 0.01322\alpha + 0.0000004247\alpha^3 - 5 \log r_0 + 5 \log r + 5 \log \Delta$,
and finally to determine the moment of maximum light by graphical or other interpolation."

This formula is that actually used in computing the value of stellar magnitude given in the American Ephemeris. α is the angle SVE, $r_0 = 0.72333$, r is the radius vector of Venus and Δ the distance from the earth.

La Plata, 1926 April 28.

REVIEW OF PUBLICATIONS

The Graphic Construction of Eclipses and Occultations, by W. F. Rigge, S.J. 157 pages. Loyola University Press. Chicago, Ill., 1924.

It has been the aim of the writer, as he explains in his preface, to present the matter to the amateur on the assumption that he is familiar with the terms of the celestial sphere and has a limited knowledge of spherical and plane trigonometry. The book should prove very interesting to those who desire to know only the nature of the eclipse problems and will be of great value to the student who is about to undertake the computation of eclipses or occultations by the more rigorous methods.

There are eleven chapters in the book, the first seven of which contain practically all the meat of the work. The headings of these chapters are: Chapter I, Lunar Eclipses; Chapter II, A Solar Eclipse for a given place; Chapter III, An Occultation for a given place; Chapter IV, A general diagram for all Occultations at a given place; Chapter V, Occultations with the aid of a Star chart; Chapter VI, Solar Eclipse Maps; Chapter VII, Occultation Maps.

The greater part of the material in the book has appeared in a series of articles running through the issues of *Popular Astronomy* from 1895 December to 1896 October, but the book includes some extra material on occultation maps and is the product of the author's riper experience in graphic construction work covering a period of twenty years. The printing and type of the book are excellent and the diagrams which number over 100 are very clear. We can recommend this book to any amateur interested in eclipses and who likes to use ruler and compass.

R. K. Y.

NOTES AND QUERIES

Communications are invited, especially from amateurs. The Editor will try to secure answers to queries.

DATES SIEGE OF TROY BY ECLIPSE OF SUN (From *Science Service*)

The Trojan War, sung by Homer in his Iliad, began in 1197 B.C., and the famous wooden horse got through the walls, opening the way for the destruction of the city, in 1187 B.C. Ulysses got home to Ithaca after his long wanderings ten years after that, and at 8.30 on the evening of April 16, 1177 B.C., he sent an arrow through the last of the suitors who had been pestering his faithful wife Penelope.

This exact dating of events that happened three thousand years ago has been made possible by the calculations of an astronomer, Dr. Schoch of Heidelberg. Using the regular astronomical methods for ascertaining the dates of eclipses, and making allowance for the retardation of the earth since the time of Homer by the brake-like action of the oceanic tides, Dr. Schoch used as his basic date the total eclipse of the sun recorded in the twentieth book of the Odyssey, where Theoclymenus addresses Penelope's suitors as follows:

> "Ah, unfortunate men, what horror is that that has happened?
> Shrouded in night are faces and heads. To the hands it descendeth.
> See, too, crowded with ghosts is the porch and crowded the courtyard. . . .
> Withered and gone is the sun and the poisonous mist is arising."

The view that these lines and those following described a total eclipse was taken by Plutarch and by medieval commentators.

Dr. Schoch examined the century within which the siege of Troy and the return of Ulysses are said to have fallen, namely 1240-1140 B.C. He concludes that the total solar eclipse of 1177 B.C. can alone be taken into consideration. In this year, on April 16, the sun was totally eclipsed in the island of Ithaca at 11.41 a.m. local mean time. He reconstructs the events of that day, as recounted in the Odyssey, and on the assumption that

this eclipse really was historical, restores the chronology of the Trojan war and subsequent events as follows:

Trojan War	B.C.	1197-1187
Fall of Troy	"	1187
Wanderings of Ulysses	"	1187-1177
Landing on Scheria	"	1177 beginning of April
Landing on Ithaca	"	1177 April 12
Slaughter of Suitors	"	1177 April 16, 6 to 8.30 p.m.

The fact that the eclipse appears, from the calculation, to have been total on Ithaca, is an important piece of evidence. The path of totality over the earth is an extremely narrow one at all times, and it is highly improbable that there has been a total eclipse in that particular spot since the time of Ulysses.

Dr. Schoch's table supplements from a different angle the attempts, hitherto entirely archaeological, to fix the date of the Trojan war. Some few years ago, several large clay tablets were dug up at Boghaz-Keui in Asia Minor. They were inscribed in cuneiform characters, such as were used by the Babylonians and the Assyrians, but were in a hitherto unknown language, almost certainly Hittite. Herr Forrer, a Swiss philologist, who claims to have deciphered some of them, states that one describes an invasion of Asia Minor during the reign of a Hittite king, who is known to have occupied the throne about fifty years before the traditional date of the Siege of Troy. Until Dr. Schoch made his calculations, this was thought to have taken place about 1172 B.C. The invaders were described as Achaeans, commanded by Atreus, who was the father of Agamemnon and Menelaus. From the Boghaz-Keui tablets, if Forrer deciphered them correctly, it would appear that the Greeks were planning to seize various districts in Asia Minor, and that Helen was a mere pretext for the war with Troy.

Notes of Travel

Mr. H. Westoby, of Guelph, writes as follows: About two years ago I went around Africa, to try and recover my health. I liked the trip, and saw many interesting places, and some glorious scenery. The South is poor in stars, as compared with the North.

As we went around the "Dark Continent", I was interested in watching Orion, which turned completely round, and was seen in all attitudes. At Johannesburg a fine 28 inch telescope has been placed from Yale, for study of the southern hemisphere. It is in the Witwatersrand University. By the way South Africa is building several fine universities. The one just mentioned is the latest, and already it has 1,200 students. At Capetown is now being erected on the Rhodes Estate another University, which, for setting can hardly be equalled anywhere. I spent a month on St. Helena, and saw where some of the instruments at the Meteorological Office on Bloor St. (Toronto) used to be, at least I was told that "the instruments were sent to Toronto". It seems strange to set up a telescope in St. Helena, since it appears to me for ever cloudy there, due to the S.E. trades; and where Halley set up his instruments (now called Halley's Mount) I am sure it is cloudy for three quarters of the year.

THE CONSTELLATIONS BY RADIO

Mr. D. R. Proctor Coats, formerly of Montreal and now of Winnipeg, is active in efforts to "broadcast" instruction in the study of the sky. He is editor of the Radio column in "The Grain Growers' Guide" and in a recent number he explained the way he transmits the shape of the constellation-figures. He asks his listeners to provide themselves with squared paper, such as is used in schools and indeed in business life for drawing curves or "graphs" to represent variations in prices or in some other quantity.

This is the formula by which he gave the positions of Polaris and of the stars of the "Big Dipper" at 10 p.m. on May 1: *P*17*x*2*y*2; *A*5.5*x*24*y*2, *B*3*x*29*y*2, *C*9*x*33*y*2, *D*12*x*30*y*3, *E*16*x*32*y*2, *F*20*x*33*y*2, *G*23*x*37*y*2. Which is interpreted as follows: Distances measured to the right from the left-hand edge of the sheet are denoted by "*x*"; those upward from the bottom, by "*y*". *P* stands for Polaris. Represent it by a dot 17 spaces to the right and 2 spaces up. The last figure, 2 in this case, gives the magnitude of the star. The first star of the "Dipper" is denoted by *A*. Place a dot for it 5½ spaces to the right and 24 spaces up, and as it also is of the 2nd magnitude the dot representing it should be of the same size as that for Polaris. Star *B* is 3 spaces to the right and 29 spaces up,

and its magnitude is 2. Similarly for the rest, but *D* being of magnitude 3 should be represented by a dot somewhat smaller. Having marked the dots in their proper places the figure of the "Dipper" is given at once, and the listener is ready for information about the various stars in the group.

Mr. Coats's station is CKY. He finds many are interested in learning about the heavens.

Astronomy by Radio

The following Astronomical Radio Talks were broadcast from WEAR and WTAM, Cleveland during 1926: A Perpetual Calendar in January; Venus, as an abode of Life in February; Mercury in March; The Moon and the Weather in April; The Stellar Menagerie in May and Our Sun and Others in June. This series of six talks were given by O. L. Dustheimer, Professor of Astronomy, Baldwin-Wallace College, Berea, Ohio.

C. A. C.

MEETINGS OF THE SOCIETY

AT VICTORIA

February 9, 1926.—The meeting was called to order at 8 p.m., with Prof. P. H. Elliott in chair, the attendance being about 45. Two gentlemen were elected to membership in the Society: Mr. H. A. Reed and Mr. T. S. Shearmen, both of Vancouver, B.C.

Predictions of phenomena of special note were given by Mr. J. A. Pearce, who described interesting objects to be looked for at present in the evening and morning skies.

A short description of the zodiacal light was given by Mr. R. M. Petrie.

The address of the evening was given by Mr. W. E. Harper on "Famous Observatories and their work".

Introducing the subject by stating that there were various ways of grouping observatories for purposes of treatment, the lecturer chose the geographical basis of grouping as being most logical and suitable. The three main groups were the European observatories, those of the Eastern coast of America, where, though no large telescopes exist, a vast amount of useful work is done and the observatories of the Western coast of America, the home of most of the large telescopes of the world.

The lecturer dealt with each observatory from its historical standpoint, its instrumental equipment and its line of work.

Greenwich, among the oldest of the European observatories, was founded 250 years ago by reason of the needs of navigation. The method of determining the accurate positions of the moon and stars necessary for this purpose was sketched briefly and views were shown of the various instruments as well as of its astronomers of the past and present. Other European observatories touched upon briefly were Edinburgh, Paris and Potsdam.

Harvard was dwelt upon longest in the case of the observatories of the east coast of America. Pickering's work on the magnitudes of the stars and the spectral studies by himself and Miss Cannon culminating in the great catalogue of over a quarter million stars classified as to their spectra were dwelt upon. The branch station at Arequipa, Peru, and the results of the photography of the southern heavens from that point were outlined and reference was made to the continuous photographic record of the heavens by a battery of small cameras.

The observatories at Allegheny, Ann Arbor, Virginia and the National Observatory of the Argentine Republic at La Plata next received attention and

interesting historical records were given of each. Some preconceived notions of the backwardness of the southern continent were shattered. The work of Langley on the sun and of Keeler on the nature of Saturn's rings was pointed to as the outstanding achievement of the Allegheny institution. The McCormick Observatory at Virginia has for its dierctor a Canadian, Dr. Mitchell, who is doing good work on the distances of the stars.

Numerous slides were shown of the four Western ones discussed, the Lick, Yerkes, Lowell and Mt. Wilson observatories. Campbell's work on the radial velocities of stars at the Lick, Barnard's photography of the heavens at the Yerkes, revealing the existence of dark nebulae, were instanced as achievements of the observatories having the large refracting telescopes. A brief sketch of Lowell's life before he dedicated his remaining years and fortune to astronomical work was given and made more interesting his discoveries leading him to believe in the habitability of Mars. The various instruments at the present western observatory at Mt. Wilson were described and the nature of the work carried on by each was outlined. Some of their photographs of the moon, the nebulae and of star clusters gave striking confirmation of the satisfactory performance of the instruments.

The lecturer's excellent address elicited expressions of admiration from the audience, and a hearty vote of thanks was tendered Mr. Harper.

March 9.—The meeting was called to order at 8 p.m., the President in the chair. The attendance was about 50.

A short talk on the binary star Algol was given by Mr. R. M. Petrie.

A debate on the habitability of Mars was announced as the subject of the next meeting, to be held on April 13.

The address of the evening was then given by Mr. F. Napier Denison on "Abnormal Weather Conditions of 1925-26". The lecturer pointed out how the precipitation has been abnormally low and the temperature abnormally high during the past winter, and that forest-fire hazard will doubtless be great unless much rainfall is experienced before summer. The importance of storm study was emphasized by the speaker who showed slides pointing out the distribution of weather and the importance to mariners of the information obtained by a scientific study of storms.

A chart of solar radiation by Dr. Abbot was displayed showing the variations in energy received during several years. Some investigators have predicted cold summers for 1926 and 1927 on the strength of these charts.

The lecturer then read reports from different parts of the globe showing how abnormal weather, both good and bad, has prevailed recently. These interesting clippings showed that Victoria has not been singled out for a mild winter, but that it is but part of a world-wide tendency.

April 13.—The meeting of the Society was held in the Girls Central School at 8 p.m., the President in the chair. The attendance was about 30.

A short talk was given by Mr. H. H. Plaskett on the heavenly bodies as they appear during the present month.

The subject of the evening was a debate on the habitability of Mars. For the affirmative, Mr. J. Duff, M.A.; for the negative, Mr. R. G. Miller.

It was pointed out by both speakers that this debate was not undertaken in any spirit of partizanship, but simply as a presentation of the cases for and against, by two of our members.

Mr. Duff presented a very good case for the habitability of Mars, adducing some very high scientific opinions in favour of the possibility or feasibility of life—some kind of life—being able to exist there. Always admitting of course, that owing to atmospheric and climatic differences, the inhabitants—if existing—would be very unlikely to bear any resemblance to ourselves. Mr. Duff's contention was that the differences in climate and atmosphere, while admittedly very great, were not nearly so much as at one time had been supposed.

Mr. Miller's case for the negative was also quite interesting and in part convincing. He based his case principally on the fact that to admit the artificiality of the Martian canals was to presuppose that Mars was entirely flat, as it would be rather senseless running straight lines or canals through mountains, etc.

The sense of the meeting however as voiced by subsequent speakers, seemed to be in favour of the habitability of the planet.

A hearty vote of thanks was passed to both speakers.

R. M. PETRIE, *Recorder.*

AT TORONTO

April 6.—The regular meeting of the Society was held at 8 o'clock in the Physics Building, the President, Mr. A. F. Hunter, in the chair.

The feature of the evening was the presentation of motion pictures of "Astronomical Phenomena". The following were the titles: "A trip to the Moon." "The Mystery of Space." "Earth and Moon." "Worlds in the Making." "Eclipses."

Mr. F. T. Stanford, the General Secretary, took charge. The pictures were quite entertaining and instructive, giving the large audience a better idea of the great problems of astronomy.

In closing Prof. Chant gave a brief outline of the work of the Royal Astronomical Society of Canada, appealing for new members.

April 20.—The regular fortnightly meeting of the Society was held in the Physics Building of the University at 8 p.m., Mr. A. F. Hunter presiding.

The President made some remarks on the location of the planets, stating that Mercury should be visible in the morning of the 28th, at sunrise. Venus is also a morning star.

A fine auroral display was visible in Toronto on the evening of the 14th inst., Prof. Chant spoke very interestingly on the subject. It was one of the most luminous and extensive displays he had seen in this locality for many years. It was notable particularly on account of its great extent, covering nearly the whole

of the visible hemisphere. In observing it, however, he found great difficulty in locating the focal point or auroral crown. In explanation of the phenomenon of the aurora borealis he thought it fairly well established that it was caused by electric discharges emanating from the sun; electric particles being shot out from the sun and on entering the earth's atmosphere giving the effect of streamers. The streamers all converging on one point was purely an optical illusion due to perspective. During displays of this nature electric services such as the telegraph were greatly disturbed.

Mr. A. F. Miller, following Dr. Chant, stated that although he had been observing the sun closely each fair day lately he had found no evidence of unusual disturbance; in fact, sunspots during the last six weeks had been less numerous, and only one of any size visible in the last week.

Mr. J. R. Collins spoke on the aurora. He described it as quite an unusual display, at one time he saw the whole sky completely covered with a flimsy cloud-like formation, quite luminous and so tenuous that the stars could be seen distinctly through it. He observed it all evening, at intervals, from about 8 o'clock until after 1 a.m.

Moving pictures were shown during the rest of the evening, taking the place of the usual paper or lecture. The reels displayed were entitled: "The Astronomer's Workshop." "Comets, how formed." "A Solar Eclipse." "Sun's effect on Earth."

A. KENNEDY, *Recorder.*

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